



GROWTH DIFFERENTIATION DURING PRE-ADOLESCENCE AMONG THE MARIA OF CHHATTISGARH, INDIA: A MULTIVARIATE DISTANCE ANALYSIS

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ABSTRACT

The Maria tribal children (6-12 years) were studied to examine the pre-adolescent growth differentiation. Altogether 445 children (boys:222; girls:223) were measured for stature, weight, head length, head breadth, bizygomatic breadth, nasal height, nasal breadth, morphological facial height, upper facial height, bignonial breadth and least frontal breadth. In order to find out the changes during growth period multivariate distance analysis was performed putting together all measurements. Findings of MMD, CPG, CSG and t-D showed that a sharp pre-adolescent growth spurt occurred between 11-12 years among the boys and 8-9 years among the girls. Pre-adolescent growth spurt thus occurred much earlier among the boys than the girls.

KEYWORDS: Physical Growth. Pre-adolescent Growth Spurt. Maria.

INTRODUCTION:

Human growth is an active dynamic process which involves incessant change in an organism not yet mature and spends nearly first two decades of their life in growing, development and training their abilities to survive. The progression of growth follows a pattern that is consistent within individual but involves a wide range of differences with regard to age of onset and duration of specific stages as well as in the intensity of these changes. However, basic developmental norms are constant for all children belonging to different ethnic groups (Valadim and Ponter 1977; c.f. Sharma 2004). Differential growth creates form, which can be external or internal. External growth rates, which differ from one part of the body to another and from one tissue to another, determine the external form. The internal form is obtained through a series of time bound events which develop each cell into a specialized complexity of its particular function. The mechanism and rate by which tissues grow have a profound implication on ultimate shape and size to which they can enlarge and the efficiency with which they can function. Further, considering the above, it is important to assess the combined effect of growth of all body dimensions at specific age in order to understand the process of growth in its holistic perspectives (Reddy and Mukherjee 1981, Mukherjee 1989).

Reddy (1980) emphasized:

"It is important to note that the magnitude of growth of a body character is important though it differs with others during the growth period. The combined effect of growth of all body dimensions is important to understand the process of growth further. This can only be studied by subjecting the measurement values of all body dimensions to multivariate distance analysis."

Multivariate distance analysis of growth is a combined measure of all body measurements put together and examine their changes during the growth period. In view of this present study was undertaken to examine the growth differentiation among the Maria of Chhattisgarh, India. Further multivariate distance analysis is performed to understand the growth in its holistic perspectives.

MATERIALS AND METHODS:

Data were collected among the pre-adolescent Maria boys and girls aged 6-12 years. A cross-sectional sample of 445 children (222 boys and 223 girls) from Kilepaal, Bastanar, Tirthum and Niyanaar villages of Bastar district, Chhattisgarh were measured on the basis of stature, weight, head length, head breadth, bizygomatic breadth, nasal height, nasal breadth, morphological facial height, upper facial height, bignonial breadth and least frontal breadth. Every care was taken to record the correct date of birth. Care was also taken to include only apparently physically and mentally normal children. All the measurements were taken following the technique of Weiner and Lourie (1969). Data of this study were collected during July-September, 2018 by the second author (Sharda Dewangan).

The Maria:

They speak Gondi (Grigson 1949), but they are quite comfortable with Halbi and Hindi. Maria tribes are agriculturists, practicing settled cultivation and also dependent on forest for food and medicine. They are patrilineal and patriarchal tribe with patrilocal rules of residence, who practice preferential marriages, that is, mother's brother's daughter or father's sister's daughter is always preferred as a spouse for a male. The Maria have a distinct identity of their own and bear a

strong sense of dependence on the supernatural power (Mukherjee 2014).

To find out the cumulative growth from 6-12 years in both the genders, the morphometric data were subjected to multivariate distance analysis. Four formulae viz, mean multivariate distance (MMD), co-efficient of percent growth (CPG), co-efficient of standardized growth (CSG) and t-distance (TD) were calculated following Reddy and Mukherjee (1981) and Mukherjee (1989).

$$\text{Mean multivariate distance (MMD)} = \frac{\sum m_2 - m_1}{6} \times 100$$

Where m_1 and 6 are mean and standard deviation of measurement at the lowest age i.e., 6 years, m_2 is the mean of measurement in the successive age i.e., 7 years, V stands for total number of measurements.

$$\text{Co-efficient of percent growth (CPG)} = \frac{\sum m_2 - m_1}{m_1} \times 100$$

Co-efficient of percent growth is the average of growth percentage per annum of growth characteristics.

$$\text{Co-efficient of standardized growth (CSG)} = \frac{\sum m_2 - m_1}{Sd_1} \times 100$$

Co-efficient of standardized growth is the average of standardized growth of each character between two consecutive age groups.

$$\text{t-distance (TD)} = \frac{\sum t}{V}$$

t-distance is the average of univariate distance between successive age groups.

RESULTS:

The mean and standard deviation values of eleven anthropometric measurements are furnished in Tables 1a and 1b for boys and girls respectively. Mean values of different measurements in all age groups increased with advancement of age with some exceptions. This is true in both the genders. More fluctuation is noticed in mean values in head length, nasal height and upper facial height among boys (Table 1a), while the same is noticed in head length, head breadth, nasal height and upper facial height among girls (Table 1b). Side by side, fluctuation of standard deviation values is noticed in stature and weight for both the genders.

A continuous increase is noticed in stature and weight in both the genders of the Maria from the age of 6 years onwards. Among the boys highest increment is noticed from 9 to 10 years for stature (7.04 cm), weight (3.51 kg) and head length (0.43 cm). In case of bizygomatic breadth (0.93 cm) and nasal breadth (0.34 cm) highest increment occurred from 10 to 11 years. In least frontal breadth (0.34 cm) highest increment is noticed from 8 to 9 years, while in case of head breadth (0.27 cm), nasal height (0.36 cm), morphological facial height (0.28 cm), upper facial height (0.84 cm) and bignonial breadth (0.44 cm) highest increment occurred from 11 to 12 years (Table 1a).

Among the girls the highest increment is noticed for stature (8.57 cm), weight (4.3 kg), head length (0.42 cm) and nasal height (0.33 cm) from 8 to 9 years. In case of head breadth (0.12 cm), bignonial breadth (0.44 cm) and least frontal breadth (0.42 cm) highest increment occurred from 6 to 7 years, while in case of bizygomatic breadth (0.5 cm) and upper facial height (0.34 cm) highest increment is noticed from 11 to 12 years. And in case of nasal breadth (0.15 cm) and morphological facial height (0.34 cm) the same is noticed from 7 to 8 years of age (Table 1b).

The girls show more value than the boys in terms of total absolute growth between 6 and 12 years in seven characters (stature, weight, head length, nasal height, morphological facial height, bignonial breadth and least frontal breadth). While, the boys show more value than their counterpart in four characters (head breadth, bizygomatic breadth, nasal breadth and upper facial height) in this respect (Table 2).

It is apparent from Tables 3a and 3b that maximum amount of percent growth is attained by weight among the boys (93.68%) and girls (107.36%) from 6 to 12 years of age, whereas minimal growth takes place in head breadth i.e. 3.67% and 1.86% among boys and girls respectively. Percent growth varies in both the genders in case of other measurements. However, like weight, stature also shows high amount of percent growth in both the genders (boys: 24.87%; girls: 25.67%).

MULTIVARIATE DISTANCE:

An attempt has been made in this section to bring out the combined growth pattern of different body dimensions by calculating four different formulae i.e. mean multivariate distance (MMD), co-efficient of percent growth (CPG), Co-efficient of standardized growth (CSG) and t-distance (T-D). Findings of MMD analysis (Table 4) is indicative of the fact that it exhibits a sharp pre-adolescent growth spurt between 11-12 years among the boys (4.40) and between 8-9 years among the girls (5.16). Results of CPG show that pre-adolescent growth spurt occur in the same age groups in both the genders like MMD (boys: 4.22; girls: 5.10). In case of CSG pre-adolescent growth spurt occurred between 11-12 years

for boys (0.53) and 8-9 years for girls (0.57). Results of T-D also show the same trend i.e. pre-adolescent growth spurt occurred between 11-12 years for boys (1.89) and 8-9 years for girls (2.17). It is interesting to note that in all these cases the girls show more values than that of the boys (Table 4).

DISCUSSION:

Growth studies in Central India are mainly on the individual or collective efforts of the anthropologists. These studies are either in the form of dissertation/doctoral reports or as research articles. Though much work has been done on growth in this region among different populations, multivariate distance analysis on pre-adolescent Maria boys and girls has not been done to the best of author's knowledge.

The composite multivariate distances based on different formulae display the pattern of total growth of the individuals instead of those for individual characters. The multivariate distance analysis in anthropological studies are mainly utilized to predict the similarities and differences between the populations studied for a set of genetic and morphological characters to get some idea about the nature of the forces which have prevailed upon in the evolutionary history of the populations (Sharma 2004).

The efficacy of multivariate distance analysis is proved by the fact that the results show a sharp pre-adolescent growth spurt among the Maria girls between 8-9 years of age and among the boys it is yet to start and the growth rate slows down between 8-9 years. On the other hand, results show a sharp pre-adolescent growth spurt among the Maria boys during 11-12 years of age. Pre-adolescent growth spurt thus occurred among the Maria girls much earlier than their counterpart.

Analysis of Sharma (2004) reveals a sharp pre-adolescent growth spurt among the Yadav girls of Eastern Uttar Pradesh between 9-10 years, whereas among the Yadav boys of Eastern Uttar Pradesh a different trend is perceptible. The study of Baruah et al. (2015) reveals a sharp pre-adolescent growth spurt between 4-5 years as well as between 7-8 years among boys and girls of the Garo of Assam, Whereas among the Rabha of Assam pre-adolescent growth spurt is noticed between 4-5 years as well as between 5-6 years among the girls, and among the boys it occurred between 4-5 years. Therefore, findings of this study do not support the findings from other parts of India. In fine, it can be said that genetic as well as environmental factors may be responsible as paraphernalia for such discrepancy.

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Table 1a: Mean and standard deviation of growth characteristics: Boys (n=222)

Growth characteristics	AGE IN YEARS						
	6 (n= 31)	7 (n=32)	8 (n=32)	9 (n=32)	10 (n=33)	11 (n=23)	12 (n=39)
Stature (cm)	114.33 (8.83)	119.45 (6.74)	125.36 (9.77)	128.24 (3.85)	135.28 (6.24)	138.67 (6.54)	142.77 (6.06)
Weight (kg)	17.09 (2.84)	18.81 (2.73)	21.69 (5.59)	24.21 (3.53)	27.76 (4.70)	31.27 (5.03)	33.10 (6.97)
Head length (cm)	16.57 (0.69)	16.81 (0.83)	16.88 (0.96)	16.84 (0.71)	17.27 (0.65)	17.26 (0.72)	17.34 (0.61)
Head breadth (cm)	13.07 (0.67)	13.10 (0.59)	13.20 (0.47)	13.26 (0.43)	13.21 (0.60)	13.28 (0.78)	13.55 (0.68)
Bizygomatic breadth (cm)	9.00 (0.73)	9.02 (0.60)	9.62 (0.60)	9.61 (0.63)	9.71 (1.38)	10.64 (0.59)	10.69 (0.80)
Nasal height (cm)	4.57 (0.31)	4.59 (0.35)	4.66 (0.61)	4.63 (0.41)	4.74 (0.43)	4.64 (0.44)	5.00 (0.52)
Nasal breadth (cm)	2.85 (0.29)	2.91 (0.20)	3.07 (0.25)	3.11 (0.20)	3.09 (0.23)	3.43 (0.36)	3.45 (0.20)
Morphological facial height (cm)	6.38 (0.37)	6.40 (0.50)	6.49 (0.49)	6.46 (0.47)	6.64 (0.48)	6.68 (0.34)	6.96 (0.70)
Upper facial height (cm)	4.10 (0.29)	4.16 (6.70)	4.13 (0.40)	4.31 (0.50)	4.30 (0.33)	4.46 (0.48)	5.32 (0.50)
Bignonial breadth (cm)	7.05 (0.78)	7.23 (0.95)	7.61 (0.97)	7.50 (0.81)	7.88 (0.84)	7.84 (0.69)	8.28 (0.82)
Least frontal breadth (cm)	10.82 (0.62)	10.84 (0.49)	11.01 (1.17)	11.35 (0.51)	11.28 (0.49)	11.61 (0.84)	11.76 (0.73)

Note: Figures in parenthesis indicate standard deviation value

Table 1b: Mean and standard deviation of growth characteristics: Girls (n=223)

Growth characteristics	AGE IN YEARS						
	6 (n=34)	7 (n=30)	8 (n=22)	9 (n=29)	10 (n=23)	11 (n= 43)	12 (n=42)
Stature (cm)	112.07 (7.11)	116.82 (6.68)	118.94 (5.44)	127.51 (4.15)	133.80 (4.48)	137.80 (7.07)	140.84 (5.15)
Weight (kg)	15.35 (2.01)	17.30 (3.28)	18.32 (2.57)	22.62 (3.23)	26.74 (3.93)	28.72 (6.55)	31.83 (4.44)
Head length (cm)	15.95 (0.55)	16.05 (0.52)	16.10 (0.65)	16.52 (0.50)	16.44 (0.77)	16.79 (0.73)	17.29 (0.66)
Head breadth (cm)	12.89 (0.52)	13.01 (0.54)	12.99 (0.49)	13.06 (0.51)	13.10 (0.86)	13.15 (0.62)	13.13 (0.54)
Bizygomatic breadth (cm)	9.09 (0.66)	9.20 (0.75)	9.56 (0.69)	9.81 (0.78)	9.94 (0.76)	9.80 (0.72)	10.30 (0.69)
Nasal height (cm)	4.35 (0.32)	4.50 (0.34)	4.54 (0.73)	4.87 (0.55)	4.75 (0.54)	4.65 (0.66)	4.87 (0.42)
Nasal breadth (cm)	2.80 (0.20)	2.89 (0.27)	3.04 (0.50)	3.13 (0.25)	3.08 (0.28)	3.17 (0.29)	3.27 (0.21)
Morphological facial height (cm)	6.00 (0.37)	6.21 (0.43)	6.55 (2.12)	6.40 (0.34)	6.55 (0.64)	6.79 (0.81)	6.89 (0.46)
Upper facial height (cm)	3.97 (0.32)	4.20 (0.28)	4.02 (0.43)	4.32 (0.24)	4.33 (0.49)	4.12 (0.60)	4.46 (0.32)
Bigonial breadth (cm)	6.56 (0.70)	7.00 (0.74)	7.36 (1.22)	7.42 (0.74)	7.82 (0.92)	8.06 (1.12)	8.02 (1.02)
Least frontal breadth (cm)	10.52 (6.52)	10.94 (0.55)	10.91 (0.63)	11.29 (0.64)	11.46 (0.59)	11.31 (0.73)	11.58 (0.70)

Note: Figures in parenthesis indicate standard deviation value

Table 2: Total absolute growth between 6 and 12 years of all characters

Characters	Boys	Girls
Stature	28.44	28.77
Weight	16.01	16.48
Head length	0.77	1.34
Head breadth	0.48	0.24
Bizygomatic breadth	1.69	1.21
Nasal height	0.43	0.52
Nasal breadth	0.60	0.47
Morphological facial height	0.58	0.89
Upper facial height	1.22	0.49
Bigonial breadth	1.23	1.46
Least frontal breadth	0.94	1.06

Table 3a: Value of percent growth of each character in different age groups: Boys

Characters	Age groups (in years)					
	6-7	6-8	6-9	6-10	6-11	6-12
Stature	4.48	9.65	12.17	18.32	21.29	24.87
Weight	10.06	26.92	41.66	62.43	82.97	93.68
Head length	1.45	1.87	1.63	4.22	4.16	4.65
Head breadth	0.23	0.99	1.45	1.07	1.61	3.67
Bizygomatic breadth	0.22	6.89	6.78	7.89	18.22	18.78
Nasal height	0.44	1.97	1.31	3.72	1.53	9.41
Nasal breadth	2.10	7.71	9.12	8.42	20.35	21.05
Morphological facial height	0.31	1.72	1.25	4.07	4.70	9.09
Upper facial height	1.46	0.73	5.12	4.87	8.78	29.76
Bigonial breadth	2.55	7.94	6.38	11.77	11.20	17.45
Least frontal breadth	0.18	1.75	4.90	4.25	7.30	8.69

Table 3b: Value of percent growth of each character in different age groups: Girls

Characters	Age groups (in years)					
	6-7	6-8	6-9	6-10	6-11	6-12
Stature	4.24	6.13	13.78	19.39	22.96	25.67
Weight	12.70	19.35	47.36	74.20	87.10	107.36
Head length	0.63	0.94	3.57	3.07	5.27	8.40
Head breadth	0.93	0.77	1.32	1.63	2.02	1.86
Bizygomatic breadth	1.21	5.17	7.92	9.35	7.81	13.31
Nasal height	3.45	4.36	11.95	9.19	6.90	11.95
Nasal breadth	3.21	8.57	11.78	10.00	13.21	16.78
Morphological facial height	3.50	9.17	6.67	9.17	13.17	14.83
Upper facial height	5.79	1.26	8.82	9.07	3.78	12.34
Bigonial breadth	6.71	12.19	13.11	19.21	22.86	22.26
Least frontal breadth	3.99	3.71	7.32	8.93	7.51	10.08

Table 4: Value of indices of various multivariate distance analysis

Multivariate distances	Age (in years)											
	Boys						Girls					
	6	7	8	9	10	11	12	6	7	8	9	10
Mean multivariate distance (MMD)	0.00	1.98	3.81	1.23	3.59	3.20	4.40	0.00	3.83	1.92	5.16	3.09
Co-efficient of percent growth (CPG)		2.13	3.87	1.84	2.92	3.71	4.22		4.21	2.17	5.10	2.70
Co-efficient of standardized growth (CSG)		0.22	0.46	0.14	0.39	0.41	0.53		0.46	0.22	0.57	0.37
t-distance (T-D)		0.88	1.56	0.86	1.14	1.53	1.89		2.03	1.00	2.17	1.43
												1.18
												1.93

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